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Risks to Student Achievement in Higher Education

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Abstract. A university system sets out to deliver educational experiences that meet set goals such as the achievement of learning outcomes for individual courses and program outcomes for degree programs. There are many factors that impact the successful achievement of student learning outcomes and therefore successful program design and implementation. If courses are not effectively designed with assessments properly aligned to learning outcomes, student achievement is challenging to measure. If faculty do not consistently adhere to college and/or university policies regarding submission of assignments, student behavior and perceptions of expectations in future courses may be skewed. In addition, students may, for various reasons make choices that result in failure to submit assignments that serve as measures of achievement for learning objectives. All of these factors could lead to a system breakdown and subsequent research location failure to meet the established goals, i.e. student learning outcomes. In this case study, an introduction to aeronautics course used to determine if the failure to submit assignments significantly impacted the achievement of stated program outcomes using a systems engineering approach. Data from core courses required for degree completion were used in the study. The results indicated that the lack of assignment submission presents a flaw in the system design and that the risk of not meeting learning objectives and program outcomes is very high when students fail to submit assignments.

Keywords: Higher Education · Systems engineering · Student Achievement

1 Introduction: Case Analysis

Balanced educational experiences, whether online or in traditional classrooms [1] require the use of varied approaches. This includes assessments that are both written in nature, such as research papers and case analyses as well as oral presentation assessments where students are practicing and demonstrating general education competencies such as public speaking and presentation development skills. This varied approach is not only warranted from an educational perspective, but it also mirrors skills and abilities students will need beyond the classroom, in the workplace. According to a 2015 Employer

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Survey conducted by Hart Research Associates [2], employers place the highest value on demonstrated proficiency in interdisciplinary skills such as written and oral communication when hiring recent college graduates. Specifically, the report found that oral communication rated an 85% on the employer priorities for most important learning outcomes. Written communication rated 82% in the same report [2].

At the research location, learning objectives are more specific than program outcomes to allow students to explore concepts on a more granular level during each individual course [3]. The cumulative impact of learning is thus measured by program outcomes that demonstrate a student's mastery of all program content. However, failure to complete the more specific assessments and effectively demonstrate mastery of a learning objective, calls into question, a student's ability to demonstrate mastery of an overall programmatic learning outcome.

At the research location, courses are built using the backward design method, where learning objectives are developed to ensure achievement of learning outcomes. Then, assessments are aligned with learning objectives and created so students can demonstrate mastery of these learning outcomes [4]. Students are asked to demonstrate mastery through a variety of educational tasks or assignments throughout individual courses to demonstrate mastery of these learning objectives which cumulatively demonstrate mastery of program outcomes. In some cases, though, to streamline the course and program, student learning outcomes are assessed by a singular activity.

The degree programs at the research location is designed with this process in mind, emphasizing the achievement of program outcomes via learning outcomes assessed in individual courses and activities. For example, one program outcomes states, "upon completion of this program, students will be able to communicate effectively using both written and oral communication skills" (Table 1).

Table 1. Factors contributing to learning objective/Program outcome achievement failure.

Program	Program outcome	Learning objective	Assessment	Measure of achievement
Undergraduate Degree in Aeronautics	Upon completion of the program, students will be able to communicate effectively, using both written and oral communication skills	Upon completion of this course, students will be able to demonstrate professional communication and oral presentation skills using appropriate media	Writing and Presentation activities	70% or above on all writing and presentation activities

2 Review of the Literature

Complex systems, such as online education often appear as wicked problems, where incomplete, contradictory and changing requirements make it extremely difficult to not only identify all of the essential components, but to also link the connections and draw meaningful conclusions to improve the overall system. Student preferences, for example, may influence risk assessment in academic decision making. Studies have found preferential differences regarding assignment formats between the genders. Males have been found to prefer multiple choice formats over essay type assessments [5]. In contrast, females have preferred essay formats [6]. A recent study sought to uncover more details regarding differences in opinion regarding various assignment types. For this study, assessment preference was defined as “imagined choice between alternatives in assessment and the possibility of the rank order of these alternatives” [7, p. 647]. Students, regardless of gender, were shown to have preferences for written assignments, like research papers. This research demonstrates that if students have preferences for certain assignments, the assumption is, they are more likely to complete them.

Additionally, risk tolerance and assessment are highly individualized and personal. However, these individualizations must be considered during systems engineering processes to allow for successful goal achievement. Specific student situations, while varied in nature can contribute to the decision-making process. At the research location students are typically non-traditional students. According to the National Center for Educational Statistics [8], non-traditional students are defined as a diverse population of adult (over the age of 24) students with work and family responsibilities along with other life circumstances that may interfere with educational experiences. Fitting a degree program into an already busy schedule can be stressful and anxiety provoking. This additional work load may lead students to prioritize and make decisions about what gets done and what doesn’t. Limited resources, like experience and knowledge can lead to poor decisions. To make the most of these limited resources, heuristics are utilized. Heuristics, or rules of thumb can be misleading. For example, the availability heuristic may lead an individual to believe that a certain decision or action is the most appropriate simply because it is the first one that comes to mind [9]. Individuals “satisfice” by seemingly considering all available options and selecting the one that seems to best meet a predetermined minimum level of acceptability [10]. Non-traditional students may be looking for the best use of their time. If an option, where they do not need to submit an assignment seems to appear, some students may take the chance. This is especially true if students can still earn a preferred grade. All of this information, accurate or otherwise contributes to the decision-making process. Furthermore, how individuals approach risks and make assessments partly depends on their understanding of the issue at hand as well as the available options [10]. For students to adequately assess their risk, definitions must be clear to them.

At the research location have the discretion to fail a student should they choose not to submit all assignments, as outlined in the syllabus. However, if students have had an experience contrary to this statement, in that a faculty member allowed them to earn a zero on an assignment and still pass the course, this information would skew the student’s definition and therefore impact their risk assessment. This reality aligns with Risk Homeostasis Theory where behavior and decisions are made with the intent of remaining within a pre-determined level of acceptable risk [11]. For instance, students who desire an honor distinction at graduation may not risk earning a low score on an assignment because a low score could take them beyond their comfortable threshold and risk the achievement of a lower grade. In contrast, students may not wish to spend any more time or effort on assignments than is absolutely necessary because they have identified a level they are willing to commit to this endeavor. For example, students may choose not to submit an assignment that is only worth 10% of their final grade because they have already determined they are comfortable with a lower final course grade. The variability of student threshold and risk determination is highly individual, making it difficult to calculate and almost impossible for an instructor and/or course designer to predict. Furthermore, given the variability in faculty expectations and behaviors, this calculation, done by students could be flawed. Where one faculty member may be flexible in allowing students to miss one or two assignments, another may not. In order to support students' ability to adequately assess their risk, definitions, such as all assignments must be submitted to pass the class, must be clearly communicated, as they are in the syllabus and uniformly adhered to by faculty.

In an attempt to tackle this wicked problem, systems engineering models and themes can be directly applied. Attempts were made to illuminate the shortcomings within the system which justify the need for further exploration. Systems engineering concepts can then be further applied to make adequate and effective adjustments to the system to ensure goals, in this case, student achievement of learning and program outcomes, are met throughout the system.

3 Methodology

This case study is an applied, descriptive research project. The techniques and methods of this project set out to inform a body of knowledge about a situation or potential problem with student learning objective and program outcome achievement to impact further understanding about the situation and potentially impact future policy [12]. A case study methodology is utilized by which an in-depth analysis of a particularly concerning condition will be explored utilizing existing data sources. Failure Mode and Effects Analysis works to identify and address the most critical concerns in processes, products or within a system [13]. As such, it was also utilized in the analysis.

Data was gathered utilizing existing online databases from the research institution; Campus Solutions and Canvas. To begin, graduate courses were removed from the sample of all courses. Then, non-relevant activities and assignments such as discussions were filtered out. Then, the sample was further limited to the academic terms of interest. The resulting data set included information regarding final grades and grades for specific assignments including high-stakes written and presentation assignments for undergraduate students during the terms identified. Furthermore, demographic data (age and gender) was collected on students from the research location. Campus Solutions system and aligned with the Canvas data. All collected data was deidentified using a seven-digit integer. Collected data was then conditionally formatted for use with Excel and SPSS, a statistical software platform. To generalize the data in this study, the Power Analysis Equation was utilized to determine adequate sample size [14].

Sample Size = {z^2 * p * (1 − p)/e^2}/{1 + {z^2 * p * (1 − p)}/{e^2N}}.

Using this formula, the original 16,040 individual data points from the ASCI 202 course for the given time period was decreased to 580 individual data points. A random sampling of 580 individual data points proved statistical sufficient for the analysis. The criteria below were students who passed (>70% overall) with at least one non-submission. It does indicate however that the 580 results are consistent with the 16,000, that no gender bias is apparent, no assignment type (written vs presentation) bias is apparent, and that overall fewer than 5% of students chose not to submit for this sample. See Table 2 (Table 3).

Table 2. Sample size criteria.

	ASCI 202			
# Activities Reviewed	**16,040**	**100.0%**	**580**	**100.0%**
Female	2180	13.59%	82	14.14%
Male	13155	82.01%	473	81.55%
Written (Total)	**7140**	**44.51%**	**271**	**46.72%**
Written (Female)	974	13.64%	45	16.61%
Written (Male)	5853	81.97%	213	78.60%
Presentation (Total)	**8900**	**55.49%**	**309**	**53.28%**
Presentation (Female)	1206	13.55%	37	11.97%
Presentation (Male)	7302	82.04%	260	84.14%
# Activities Meeting Criteria	**562**	**3.50%**	**17**	**2.93%**
Female	94	16.73%	3	17.65%
Male	436	77.58%	12	70.59%
Written (Total)	**280**	**49.82%**	**7**	**41.18%**
Written (Female)	40	14.29%	1	14.29%
Written (Male)	224	80.00%	5	71.43%
Presentation (Total)	**282**	**50.18%**	**10**	**58.82%**
Presentation (Female)	54	19.15%	2	20.00%
Presentation (Male)	212	75.18%	7	70.00%

Then, a stratified sampling approach was utilized to randomly select 580 individual data points from the original data set. A stratified sampling approach is a probability sampling technique that allows for an adequate sample by reducing error during random sampling [15]. To accomplish this randomization, each of the original data points were assigned a random number from zero to one. Data points for this study included score on the individual assignment, overall course score, gender and age.

Table 3. Minimum sample size calculation.

Minimum Sample Size Calculation		
Confidence Level	0.95	0.95
P	0.5	0.5
Error	0.04	0.04
Population size	16040	2749
alpha/2	0.025	0.025
Z-score	1.95996	1.95996
Sample Size	578.577	492.659
numerator	600.228	600.228
denominator	1.03742	1.21834

4 Results

The FMEA analysis produced some interesting findings. As was expected, the risk for failure to master learning objectives (LO) and program outcomes (PO) is elevated when students fail to submit assignments. Failure to submit all assignments, resulting in not mastering program outcomes (RPN = 125) was found to pose the highest risk to achievement of learning outcomes. Assignment weights also showed an elevated risk for student achievement of learning outcomes with an RPN of 75. As illustrated in the course breakdown, "freshmen level courses" included higher weights for presentation assignments than "senior level courses". This may communicate an inaccurate deemphasizing of these assignments by students. Again, the statistics from this study informed the rating. While this may have been a concern for the students who opted out of submitting assignments, weights did not seem to impact the majority of students in this sample. This reality impacted the probability rating for this potential failure mode (probably rating = 3).

Perhaps surprisingly though, was the RPN for delayed course completion. While this is not something that was explored in this research project, retention and attrition is a concern at the research location and could be a potential factor when considering system requirements. This should be explored further in future studies.

With an RPN of 25 each, compound learning objectives and faculty adherence to assignment submission policy in the syllabus are found to carry quite a risk to student learning outcome achievement. As discussed previously, failure of an instructor to adhere to the policy in the syllabus which states that students may fail the course if all assignments are not submitted, directly relates to the failure to meet set learning objectives and potentially associated program outcomes. Furthermore, and perhaps more indirectly, experience with a faculty member who allows students to pass the course without submitting all the assignments may contribute to mental models and inform student risk assessment which could lead to similar behavior in future courses. In addition, compound learning objectives and program outcomes make achievement difficult to measure. A compound objective or outcome includes the word "and". Including more than one criterion in a learning outcome such as "upon completion of this course, students will be able to communicate effectively using both written and oral communication skills" cannot be adequately assessed and therefore measured. For more accurate and specific assessments, associated learning outcomes must have a singular focus.

5 Conclusions

This case study set out to illuminate the facts surrounding a given situation. It was hypothesized that student decisions about submitting assignments negatively impacted their achievement of learning objectives and program outcomes given the research on student perceptions and the application of a systems engineering approach on the achievement of learning outcomes in higher education. This decision questions the mastery of stated learning objectives and program outcomes.

FMEA results found that the risk of not meeting learning objectives and program outcomes is very high when students fail to submit assignments. The analysis provided insight on various contributing factors. First, compound learning objectives and program outcomes make it difficult to adequately measure student achievement. This project justified the liability and increased risk posed by compound objectives and outcomes. It is recommended that all courses be audited to correct any compound objectives/outcome as well as to ensure the measurability of the associated assessments. Furthermore, and related to course design, the assignment weights resulted in a high RPN and so are considered potentially problematic. During the necessary assessment audit, assignment weights should be revisited to ensure proper weight is given to learning outcome assessments. Along with these tasks, college administrators should review their decision to design courses with single points of assessment to ensure this is indeed the path they want to follow. Related to single points of assessment, next, given the weak language in the syllabus and the general discretion afforded to the faculty at the research location, students can successfully pass a given course without submitting all assignments and potentially not master all learning objectives. Verbiage from the syllabus should be strengthened to avoid ambiguity. Rather than "may" it should say "will". Strengthening the language in the syllabus and providing adequate training around submission expectations for faculty and students is recommended. References to the importance of completing all assignment should be included in the Online Student Readiness Course available to all incoming students as well as reviewed in the required initial and recurrent training for faculty. This would ensure that all students complete the work that demonstrates mastery of the learning objectives and program outcomes that contributed to the course design. This policy change would support the single point of assessment decision and contribute to the successful transfer of knowledge in a higher education setting.

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Participants' Perspectives on Design-Build Experience: A Qualitative Exploration

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Abstract. It has been established by pedagogues that for understanding and applying the knowledge, education must have both abstract and concrete components. In professional degree programs, the abstraction could be achieved through classroom teaching. However, for the longer retention of the acquired knowledge and contextually appropriate applications, the learning environment must closely resemble the work environment. A design-build studio in architecture education is one such format designed to resemble the architectural practice and to create a better learning environment for its participants. The pedagogy of design-build studios uses tools of experiential learning like role-playing, reflective practice, etc. Although, the existing literature on design-build studios present substantial elaborations on participants' learning; there is marginal documentation of the participants' perspectives on their experience. This paper presents the process of analyzing open-ended responses from sixty-six participants of a design-build project conducted at the School of Planning and Architecture, Bhopal, India. In addition, the study elaborates a major theme 'evaluating design-build learning' that emerged from the data along with five sub-themes. This qualitative exploration helped in understanding the deeper meaning of design-build studios and their effect on participants' learning. Also, it helped in evaluating the design-build pedagogy for architecture education.

Keywords: Experiential learning · Architecture education · Design-build Studio · Participants' perception · Qualitative exploration

1 Introduction

Experiential learning is a powerful tool that brings about deep levels of learning and change [1]. Based on the elements of experiential learning theory, design-build pedagogies flourished in the institutes of many countries. Architecture education is adopting this pedagogy to transform the ways of teaching and learning. Moreover, there is a need to find a teaching tool to bridge the gap between academia and the practice of architecture [2]. Design-build studios provide real experiences to the participants by immersing them in actual scenarios of designing and building. The positive learning outcomes of

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design-build studios have been documented in the literature but the dialogues on the measurement of learning in the participants are limited. The documentation of the participants' perspectives on design-build experience in a studio conducted at the School of Planning and Architecture, Bhopal, India, brings to light various subthemes within the rubric 'evaluating design-build learning'.

2 Experiential Learning and Learning Theories

The relationship between experience and learning has its roots in various learning theories. *Rationalism* believed in reasons while *Empiricism* relied on senses for acquiring knowledge. Kolb placed both the learner and the experience at the center of the learning process. In such a process, students learn from their experiences and by reflecting on their experiences. Silberman clarifies the distinction of such a process from that of a lecture-dominated teaching format.

"Experiential Learning is used to signify any training that is interactive, with minimal lecture (and slides)" [1].

Dewey's educational theory supported both knowledge (theory) and action (practice) as the components of learning inquiry and was based on Realism (reality). Before Deweyan Pragmatism, theorists believed theory and practice were independent of each other. Later, many theorists developed educational theories based on Dewey's ideas. *Constructionism* believes in the tangible parts of the learning process, whereas *Constructivism* holds on to the various cognitive theories where learner makes a unique meaning of what they learn [3].

Salama's theory for knowledge integration in architecture education focuses on human behavior and people-environment research. The inquiry component of his theory uses experiential learning as the mechanism of inquiry by which knowledge is acquired [4]. Branislav mentions the connection of experiential learning with the design-build concept [5].

2.1 Architecture Education

In addition to providing knowledge and skills, education has a deeper motive of transforming the human being from within to bring positive changes in society and the world at large. Similarly, architecture education empowers the students with the knowledge and skill required to bring such changes to the users of buildings. Architecture education must provide the students with the opportunity to reflect on their identity and relate it to the responsibility towards the profession and society. To achieve deeper motives of education, participants must reflect on the experiences and gaining knowledge through the transformation of experiences [6]. Design-build studios provide the opportunity to realize such a pedagogical approach.

2.2 Design-Build in Architecture Education

Design-build in architecture education relies on the formal and informal components of teaching and learning. Where *formal is deliberate* and *informal is incidental*. In design-build studios, participants are involved in designing and building a product or structure. In such studios, sometimes participants communicate with the stakeholders, investigate materials, work individually or as a team, and make prototypes or actual structures at full scale. The scale of the project often depends on the duration and objectives of the studio, the number of participants, and the resources available.

3 The Design-Build Studio at School of Planning and Architecture, Bhopal

A three-week design-build studio was conducted at the School of Planning and Architecture, Bhopal with the intent of 'the understanding of local materials in addition to respecting the context and the site' (Fig. 1 and Fig. 2). A total of seventy-five students worked in a team of seven and there were a total of twelve teams. An open-ended questionnaire was distributed to the students on the day of the exhibition and review. Sixty-six students' responses were collected. During the initial stage of the study, open-ended questions were framed to get students' perceptions on their 'working effectiveness as a team', 'learning in group work', and to know their response on 'working in design-build group work projects'. The responses to these questions gave a fair idea of their learning experiences in design-build studios.

Fig. 1. Participants' discussing their design Photo Credit: Participants' Team.

Fig. 2. Participant chiseling the bamboo Photo Credit: Participants' team.

3.1 The Process of Qualitative Exploration

The responses received from the students were transcribed and the data was split into segments and a code was assigned to the relevant segment. To find patterns in the data the codes were repeatedly used wherever required that reinforced the perspectives among multiple participants [7]. The data set from open-ended responses were analyzed through the coding process. Later, the codes were merged to form categories and subcategories (Fig. 3 and Fig. 4). The categories that emerged from the codes helped in developing the list of design-build learning outcomes. Six categories emerged from the data; however, within the scope of this paper, only one category ‘Evaluating Design-build Learning’ has been presented. Five subcategories derived after merging the codes helped in understanding this category.

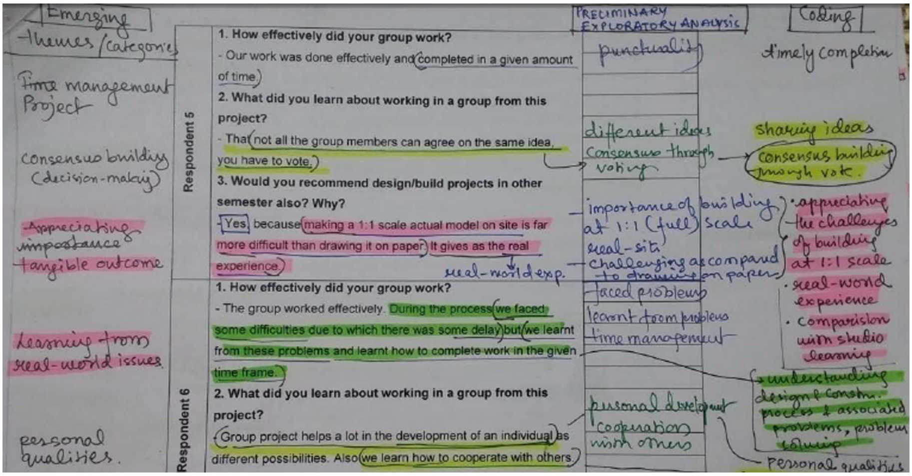

Fig. 3. Sample of manual coding

Subcategory	Code
Quality of Experience	Appreciating the challenges of building at 1:1 scale on real site
	Importance to off-studio learning
	Solving Real-problems
	Hands-on experience with the material (In Vivo)
	appreciating tangible outcome
	learning on-site decision making
	Excitement
	Maturity in work

Fig. 4. Sample of codes merged to develop subcategory

The participants' responses to which the codes were assigned and later merged to develop a subcategory are presented in the samples (Fig. 5 and Fig. 6) below:

Subcategory 1: Quality of Experience		
S.No.	Code	Participants' Response
1	Appreciating the challenges of building at a 1:1 scale on real site (Descriptive Code)	"….making a 1:1 scale actual model on site is far more difficult than drawing it on paper. It gives us real experience."
2	Importance to off-studio learning (Descriptive Code)	"Working on the field is an amazing experience and a better learning process than sheets and books."
3	Solving Real-problems	
4	Hands-on experience with the material (In Vivo)	"As it was a hands-on project, we learned from the material selection to the application of it. This could not be learned through studio work."
5	appreciating tangible outcome	
6	learning on-site decision making	"We did not plan our design on a bench/bedroom/studio. We designed it when we were in the sawmill. The design and inspiration on
7	Excitement	
8	Maturity in work	

Fig. 5. Sample of participants' response

Subcategory 2: Appreciating the Process of Working with Real Material		
S.No.	Code	Students' Response
1	Procuring Material	"…understanding the properties of materials. Techniques, joinery, etc. in a better way."
2	bringing the material to the site - tiresome	"..good exposure to field works, market survey, and material properties."
3	Ability to work with real-material	"I learned different types of joineries and even how to join bamboo."
4	Materiality	
5	Techniques	"…market survey and how to bargain."
6	Joinery	"We learn many things like how we can use the material in different ways. Mainly it was a good

Fig. 6. Sample of participant' response

3.2 Observations

The study was initiated to understand the collaborative skills that developed overtime among participants of the design-build studio. With this intent, the open-ended questions were circulated to the participants to know their perspectives and understand the impact of this pedagogy on the participants' learning. The qualitative exploration of the participants' perspectives on the design-build experience through the coding process revealed some major categories.

'Evaluating design-build learning experience' emerged as one of the major categories from the transcribed data. Five subcategories corresponded to this major category: (1)

Quality of Experience; (2) Appreciating the process of working with real-material; (3) Design-build process; (4) Suggestions; and (5) Challenges.

'Appreciating the process of working with real material' and 'design-build processes were ordinary subcategories as the researcher was expecting them in the students' responses. Whereas, quality of experience, suggestions, and challenges were the unexpected subcategories.

The findings from this study could be used to conduct a design-build studio, where the suggestions and challenges informed by the participants could help to overcome some of the constraints to conduct these studios.

3.3 Discussion

The open-ended questions initiated the thinking process of participants to reflect on their design-build experience. The experience of working with each other, investigating materials, exposure to real-world conditions, and celebrating the tangible outcome had a positive effect on participants' learning. The five subcategories define the major category 'Evaluating Design-build Learning'.

Quality of Experience: Participants' perspectives reflected the quality of design-build experience which was both rewarding and challenging. They compared it with studio-based projects and found it more realistic. The participants mentioned the moments when they felt excited about the decisions they made themselves and when their ideas took shape on the ground.

Appreciating the process of working with real material: Hands-on materials connect thinking with the making. Participants appreciated the process of material exploration. Involving in this process informed participants to relate material types and workability with space designing. Choosing the right material for construction engaged participants in understanding properties and joinery details, surveying the market for prices, and using the material in different ways.

Design-build Process: The interactive process of design-build was mentioned in the participants' perspectives. They appreciated the studio approach of working on the site. Their views on the design-build process matched with the learning theories that encourage linking theory with practice.

Suggestions: Participants' responses suggested some improvements like increasing the duration of the studio, including participants' evaluation after the project is complete, and funds to be arranged by the institute.

Challenges: Exposure to the real-world also means facing certain real challenges that are visible in students' perspectives. Depending on the scale of the project the duration of the studio is decided or vice-versa. But it is felt by many participants that due to time constraints certain hasty decisions are made. There are delays due to the unavailability of materials and budget is always a constraint as it affects the material selection and eventually affects the design. Among the group of participants, conflicts on certain decisions are there.

Despite the entire challenges and issues that arose from the participants' perspectives, it was observed that the design-build experience was appreciated for its interactive nature, be it with people, peers, materials, or tools. The fun and feeling of learning with each other and touching the real tools and materials to produce a tangible product were found exciting by the participants. The process of designing and building is not the only part of these studios; it is the involvement of the senses of the participants to give deeper meaning to their learning which was well evident through their perspectives when they evaluated their experiences.

4 Conclusion

Design-build studios provide participants with a setting that facilitates immersive engagement and interaction. It provides an opportunity for interaction between participants, clients, and stakeholders, and studio instructors to get information and find solutions to design and construction-related issues. Since 'designing', 'building', 'redesigning', and 'modifying' are parallel and on-site processes, participants can reflect on the physical expression of their ideas, and knowledge is generated through the transformation of experiences as outlined by Kolb [6]. The whole process from project inception to fabrication keeps the participants engaged. The learning in this context could be related to Higher Order Thinking as mentioned in Bloom's Taxonomy. The pedagogy of design-build studios encourages participants to 'apply their knowledge in real situations', 'analyze the changes that are needed', and 'evaluate their learning'. The studio starts with abstract components explained through lectures and discussions. As the studio advances to the development of initial ideas, with subsequent stages reinforced with the exposure to the real-world conditions, the participants move from 'abstract' to 'concrete' through the process of building. The application part of the learning process makes design-build studio different from studio-based pedagogy.

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